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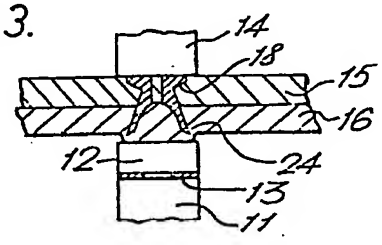
(54) Rivetting apparatus and method.

(57) A portable or fixed rivetting system incorporates a base 11, a punch 14 and a flat anvil 12 having a substantial inertia and movable on base 11. A hollow rivet 17 is driven by punch 14 through sheet 15 and into sheet 16. A piercing edge 22 of the rivet cuts through sheet 15 and penetrates substantially into sheet 16. When the anvil 12 retracts to base 11 and increased rivetting force causes protuding portion 23 to flow outward, expanding the end of the rivet and thus setting it.

FIG.3.



EP 0 129 358 A2

RIVETTING APPARATUS AND METHOD

This invention relates to rivetting apparatus and to a method of rivetting. The invention is particularly but not exclusively concerned with a rivetting system for rivetting sheets in which a rivet with a preformed head is used and in which on the opposite side of the workpiece from the head the rivet is substantially flush with the surface of the workpiece.

According to a first aspect of the invention there is provided a method of rivetting comprising the steps of holding a flat anvil against a workpiece, driving the shank of a hollow shanked rivet into the workpiece from one side by means of a punch,causing the rivet to deform the workpiece by producing a projection of workpiece material on the other side of the workpiece and thus displacing the anvil, and subsequently deforming the rivet radially outward by further compression of the workpiece between the punch and the anvil so as to cause the projection and with it part of the rivet to flow radially outward as the projection is compressed axially.

According to a second aspect of the invention there is provided rivetting apparatus for carrying out the method detailed above comprising: a flat anvil for holding against a workpiece and a punch arranged to drive a hollow shanked rivet into the workpiece from one side thereof, the anvil being displacable to permit the rivet to deform the workpiece by producing a projection of workpiece material on the other side of the workpiece, and the anvil and punch being arranged to compress the workpiece subsequently to cause the projection and with it part of the rivet to flow radially outward.

Preferred features of the invention will be apparent from the subordinate claims of the specification.

An embodiment of the invention will now be described, merely by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a diagrammatic representation of rivetting apparatus, a rivet and a workpiece at the commencement of a rivetting operation; and

Figures 2 and 3 correspond to Figure 1 but show an intermediate position during the rivetting operation and the final position with a completed rivetted joint.

Referring to Figure 1, the apparatus comprises a base 11 on which is supported an anvil 12 with a flat upper surface. The anvil has a substantial mass to provide it with inertia and is supported in such a way that it is movable along the rivetting axis, in this case vertically, with respect to base 11. In this example, a belville spring 13 is provided between the base 11 and the anvil 12 both to provide some resistance to movement of the anvil towards the base and to allow the anvil to recover its original position as shown in Figure 1 after a rivetting operation. The belville spring 13 is shown merely as a diagrammatic representation of a means for controlling movement of the anvil 12. As an alternative, which may be preferable, the movement of the anvil 12 with respect to the base 11 may be controlled hydraulically. The required movement of the anvil 12 may also be provided by the resilience of the base 11 or anvil 12 or the structures on which they are mounted.

The apparatus also incorporates a movable punch 14 which is powered to be moved towards the base 11 by means not shown in order to effect a rivetting operation.

The anvil 12 is provided with a flat upper surface so that precise alignment between the punch 14 and the anvil 12 is not required. If there is a slight misalignment between these components a rivetting

operation can still be carried out as long as at least a part of the flat surface of the anvil is aligned with the punch 14.

The apparatus is shown in Figure 1 with a workpiece consisting of two sheets 15 and 16 which are to be rivetted together. A rivet 17 is also shown supported against the punch 14. Figure 1 shows the punch 14 in a position where it has just begun to drive the rivet 17 into the first sheet 15 but prior to rivetting the punch would be retracted from the position shown to allow a clearance for insertion of sheets 15 and 16. The rivet 17 should be of a material which is harder than the sheets 15 and 16. For example, sheets 15 and 16 may be of unhardened metal such as mild steel and rivet 17 could be made of a harder material but with sufficient ductility to enable the rivet to be set. Alternatively the sheets 15 and 16 could be fibre-board panels intended as interior trim for a motor vehicle while rivet 17 is of a ductile metal.

The rivet 17 has a countersunk circular head 18 and a hollow tubular shank 19. Shank 19 has in this example an upper portion 20 with a relatively thick wall and a lower portion 25 with a relatively narrow wall thickness to form a deformable portion which can be set as the rivet is loaded axially. At its lower end, the rivet terminates in an annular piercing edge 21 which is tapered to a knife edge to facilitate entry of the rivet the sheets 15 or 16. For some applications the stepped wall thickness and the knife edge may not be necessary. The length the rivet shank 19 is preferably selected in relation to the workpiece thickness such that the shank 19 does not penetrate completely through the workpiece. Sealed joints can thus be formed.

The nature of the rivetting operation can be seen by comparing Figures 2 and 3 with Figure 1. As the punch 14 pushes the rivet 17 towards the base 11 and the anvil 12, the piercing edge of the rivet 17 cuts into the sheets 15 and 16. During this operation, the inertia

associated with the mass of the anvil 12 and the force of the spring 13 hold the anvil clear of the base 11 until after the rivet 17 has passed completely through the first sheet 15 and penetrated substantially into the second sheet 16 as shown in Figure 2. At this stage the rivet head 18 comes into contact with the first sheet 15. During this part of the rivetting operation a disc 22 is cut or punched out from the first sheet 15 by the rivet 17. This disc is held captive within hollow shank 19 of the rivet and is forced up into the narrower part 20 of the shank so that it becomes firmly retained. The rivet 17 also causes the surface of the workpiece opposite to the punch to be displaced axially to form a protuding portion 23. During further movement of the punch 14 the anvil is driven towards the base 11 until the anvil reaches the position shown in Figure 3 in which it is supported directly and positively against further movement by the base 11. This is illustrated in Figure 3 by a complete flattening of the belville spring 13 but other forms of positive stop may be provided. Further movement of the punch 14 against the positively fixed anvil 12 causes the protuding portion 19 of the rivet to be deformed outward as illustrated in Figure 3. During this deformation, the rivet is expanded outward by the outward flow of the workpiece as the protuding portion is flattened. Further movement of the punch 14 causes the rivet head 18 to be at least partially embedded in the first sheet 15 as illustated in Figure 3. This completes the rivetting operation apart from retraction of the punch 14 and removal of the rivetted workpiece. In the completed rivetted joint, a substantially flush surface results at the side of the joint where the rivet has been set. Also, depending on the materials employed and the impact applied to the punch, a substantially flush surface can be provided on the head side of the rivet.

The rivetting apparatus described above can be fixed or portable. The anvil 11 and the punch 14 can, for example, be mounted on robotically controlled arms which move them into desired operating positions.

CLAIMS

1. A method of rivetting comprising the steps of holding a flat anvil against a workpiece, driving the shank of a hollow shanked rivet into the workpiece from one side by means of a punch, causing the rivet to deform the workpiece by producing a projection of workpiece material on the other side of the workpiece and thus displacing the anvil, and subsequently deforming the rivet radially outward by further compression of the workpiece between the punch and the anvil so as to cause the projection and with it part of the rivet to flow radially outward as the projection is compressed axially.

2. A method as claimed in claim 1 wherein the length of the rivet shank is selected in relation to the workpiece thickness such that the shank does not penetrate completely through the workpiece.

3. Rivetting apparatus for carrying out the method of claim 1 comprising: a flat anvil for holding against a workpiece and a punch arranged to drive a hollow shanked rivet into the workpiece from one side thereof, the anvil being displacable to permit the rivet to deform the workpiece by producing a projection of workpiece material on the other side of the workpiece, and the anvil and punch being arranged to compress the workpiece subsequently to cause the projection and with it part of the rivet to flow radially outward.

4. Rivetting apparatus as claimed in claim 3 in which the anvil is supported with respect to a base and is movable towards and away from the base, the arrangement being such that, in use, the anvil is displaced towards the base as the said projection of workpiece material is produced and is positively supported by the anvil as the workpiece is subsequently compressed.

5. Rivetting apparatus as claimed in claim 3 or 4 in which the anvil and the punch are carried by robot arms for moving them into desired operating positions.

FIG.1.

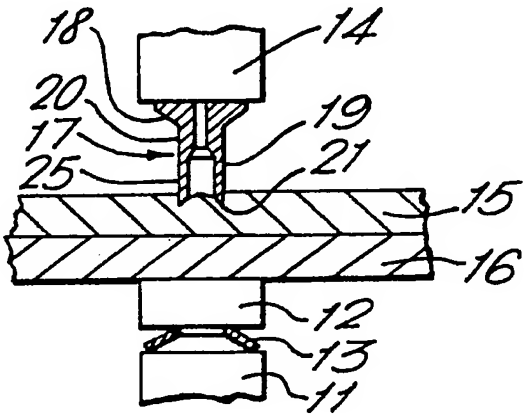


FIG.2.

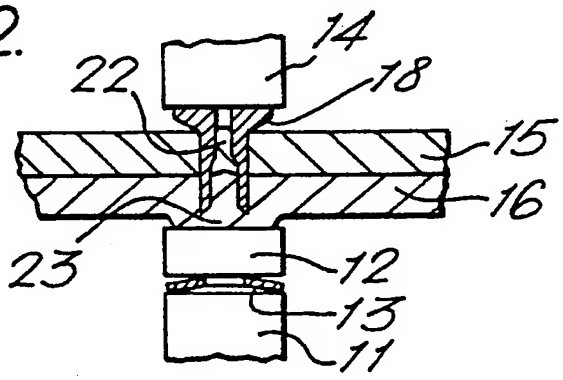


FIG.3.